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LARIX
(larches)

The larch genus (*Larix*) contains 10 species in North America, Europe, and Asia, though a few others have been named in northern Asia. Larches are native only in cooler temperate regions of the north half of the Northern Hemisphere, growing south to mountains in Himalayas. Two of the three North American species have some commercial value.

The trees have thick bark, scaly or sometimes furrowed. An outstanding characteristic of this genus is the deciduous foliage, generally pale green or bright green, turning yellow in autumn before falling. Leaves are borne singly or alternate on long shoots but on short, spur shoots are numerous and densely clustered. The slender, flexible needles are 3-angled, flattened, or sometimes 4-angled in cross section.

Male and ovulate strobili are borne singly in spring before the leaves from buds on spur shoots. The upright oblong or rounded cones mature the same year but persist indefinitely. They have many or several rounded scales. The long-winged seeds are paired at base of a scale. Cotyledons usually 6.

F–308977

WESTERN LARCH (*Larix occidentalis* Nutt.)

Other common names: Hackmatack larch, Montana larch, mountain larch, tamarack, western tamarack.

Western larch occurs only in the Upper Columbia River Basin of North America. This large American larch grows from southeastern British Columbia through western Montana west of the Continental Divide to an area in the Bitterroot Mountains. It is found generally north of the Salmon River in Idaho and in northeastern Washington. Its range includes the east slopes of the Cascades in Washington and north-central Oregon, and in the Wallowa and Blue Mountains of northeastern Oregon and southeastern Washington.

HABITAT CONDITIONS

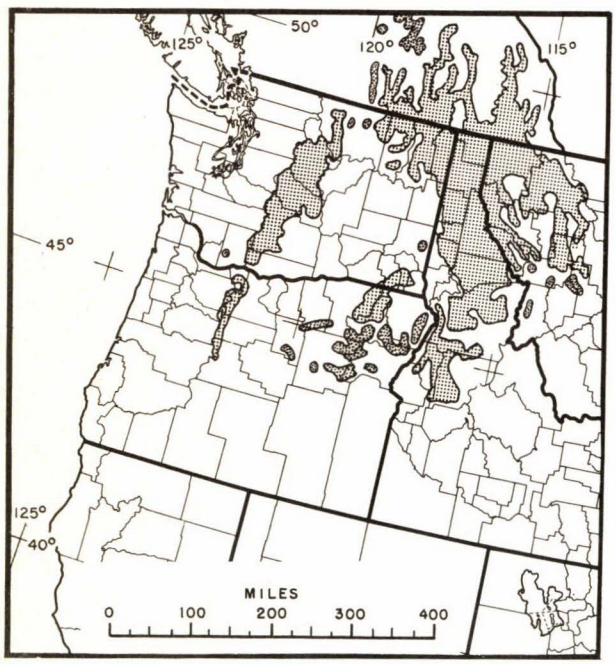
Climate

Larch grows in a climatic zone having cool temperatures and an average annual precipitation of 28 inches (*6*, *16*, *21*).[1] Only 20 to 30 percent falls in summer; the months of May through August receive 5 to 7 inches. The minimum annual precipitation it tolerates is about 18 inches. Rainfall of as much as 35 inches is known in a few larch forests. Peak precipitation of about 4 inches per month occurs in December and January in western Montana and just over 4 inches per month in November, December, and January in northern Idaho. Snowfall ranges from 40 to more than 80 inches (*21*).

Mean temperatures in western Montana range from a low of 21° F. in January to 41° in April, and reach a peak of 60° in July. The same temperature pattern prevails in northern Idaho, but respective values are 2° to 3° higher.

Mean air temperatures are above 43° F. for 160 to 175 days during the year (*21*). The last spring frost usually occurs about the first week in June and the first fall frost occurs about the last of August or first of September (*16*). However, frost is likely during every month of the year. Temperature extremes range from −49° to 107° (*21*).

[1] Italic numbers in parentheses refer to Literature Cited, p. 240.



F–506602

The range of western larch.

Soils and Topography

Western larch grows best on deep, porous soils of mountain slopes and valleys that may be gravelly, sandy, or loamy in texture. Extensive soil surveys within the type have not been made, but the soil association is generally classified as gray-brown podzolic. Moisture equivalent of the top 20 inches of soil in northern Idaho and adjacent Washington ranges from 23 to 45 percent, and pH from 5.50 to 6.40 (*10*).

Western larch characteristically occupies northerly exposures, valley bottoms, benches, and rolling topography. Southwest exposures ordinarily are not favorable sites for larch (*6*). It occurs at 2,000 to 5,500 feet in the north and up to 7,000 feet in the southern part of its range (*16*, *21*, *36*). Occurrence at higher elevations probably is limited by temperature.

Associated Trees and Shrubs

Western larch occurs throughout the transition forest, described as a peninsula of tree associates that extends east across northern Washington and southern British Columbia and expands north and south on the west slope of the Rockies (*8*). It has been classified by various authors as the climax *Larix-Pinus* association of the *Thuja-Tsuga* formation; as a subclimax species held indefinitely, chiefly by fire; and as a seral or temporary species at least in northern Idaho and

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adjacent Washington and perhaps in western Montana (*10*). In this area larch is considered a major seral species in the following associations, or basic units of climax vegetation: *Picea-Abies/Pachistima*, *Thuja-Tsuga/Pachistima*, *Thuja-Pachistima*, *Abies grandis/Pachistima*, and *Pseudotsuga/Calamagrostis*. It is a minor seral species in the *Picea-Abies/Menziesia*, *Picea-Abies/Xerophyllum*, and the *Pseudotsuga/Physocarpus* associations.

Classified on the basis of existing forest cover, larch is found in the following forest cover types:

Type No.	*Type*
	Major Component
212	Larch—Douglas-Fir
213	Grand Fir—Larch—Douglas-Fir
214	Ponderosa Pine—Larch—Douglas-Fir
	Minor Component
205	Mountain Hemlock—Subalpine Fir
206	Engelmann Spruce—Subalpine Fir
210	Interior Douglas-Fir
215	Western White Pine
218	Lodgepole Pine
237	Interior Ponderosa Pine

The larch—Douglas-fir forests are found commonly in northern Washington, Idaho, Montana, and southeast British Columbia. Minor associates in the stand are lodgepole pine, grand fir, western white pine, ponderosa pine, western redcedar, and subalpine fir. Along the east limits of the type, western larch is replaced by interior Douglas-fir. *Pachistima myrsinites*, *Vaccinium membranaceum*, *Menziesia ferruginea*, and *Rubus parviflorus*, are usually numerous among the shrubs in this cover type.

The grand fir—larch—Douglas-fir combination occurs along the east slopes of the Cascade Range, the Okanogan highlands in northern Washington, and in Idaho, Montana, and the northern Blue Mountains of Oregon. Associates are usually western hemlock, western white pine, Engelmann spruce, and ponderosa pine. *Pachistima* occurs in this type as well as *Berberis nervosa* and *Physocarpus malvaceus*.

In the mixture of ponderosa pine—larch—Douglas-fir, ponderosa pine is present in significant amounts but does not predominate. In western Montana, Idaho, eastern Oregon, and Washington, the type occupies intermediate zones between ponderosa pine and the more moist larch—Douglas-fir sites. Grand fir, western white pine, and lodgepole pine are sometimes present in minor amounts. Characteristic shrubs are *Physocarpus malvaceus*, *Amelanchier alnifolia*, and *Arctostaphylos uva-ursi*.

LIFE HISTORY

Reproduction and Early Growth

Flowering, seed production, and dissemination.—Flowering was observed to be in progress the middle of May at 3,000 feet elevation near Kalispell, Mont. The cones, 1 to 1½ inches long, ripen by the end of August or early September. Seed is shed during favorable periods afterwards. Cones fall from the trees throughout the following winter, but frequently many remain through the next summer.

Seed is produced only infrequently before age 25 (*25*), but vigorous 8-year-old seedlings have borne cones. At 40 to 50 years larch bears abundantly and continues to bear for 300 to 400 years (*36*). Only the codominant and dominant trees produce significant amounts of seed in stands.

Although about 80 seeds may be produced by a mature cone, the number of full-sized, sound seed is usually one-half this number. During an excellent seed year sawtimber-size trees may produce 22,000 sound seeds per tree (*32*). Trees averaging 22 inches d.b.h. can produce five times more seed than those averaging 14 inches d.b.h. (*31*).

Larch is a good seed-producer. Records for 22 years, covering most of the larch range, showed that the ratio of fair or good crops to poor crops is 1 to 1 (*3*). This same ratio prevailed for a 6-year period on the Coram Experimental Forest in northern Montana. Nevertheless, a fair or good crop does not always follow a poor crop. Several consecutive fair or good crops may be followed by several consecutive poor crops (*3*). Intervals between good crops averaged 4.7 years over a 14-year period in the Western White Pine Type (*14*).

Seed-tree cuttings on the Coram Experimental Forest, with 4 to 5 codominant and dominant seed trees plus 12 smaller trees per acre, produced the following:

Year	*Sound seeds per acre*
1949	43,000
1950	17,000
1951	400
1952	400,100
1953	5,600
1954	701,700

The percent of soundness of larch seed correlates directly with crop size. For the yields reported above, only 9 percent of the poorest seed crop was sound, but soundness increased progressively to 16 and 30 percent for fair crops and 32 to 38 percent for the best crops. Another study showed that seed soundness was only 5 percent in a poor seed year, compared to 42 percent in a good year (*34*).

Most seed is shed soon after ripening in the fall. At the Coram Experimental Forest, latitude 48°25′ N. at 3,700 feet, 19 percent of the sound seed was dispersed by mid-September, another 65 percent by mid-October, 15 percent of the remainder of the seed fall through spring, and 1 percent the following summer.

Larch seed dispersal in northern Idaho followed the same pattern, with two-thirds or more of the seed shed by late fall as shown in the following tabulation (*14*).

Period	Percent of seed dispersal from—	
	75-year-old stand	300-year-old stand
Midsummer to August 31	24	5
September, October	54	61
November 1 to midsummer	22	34

The small seed (143,000 per pound), aided by relatively large wings, is carried substantial distances by wind. The number of sound seed under a seed tree decreases rapidly up to about three tree heights, or 400 feet, from the tree. The seed density from this point to about 800 feet from the source remains at a fairly constant low level. Only about 5 percent of the total sound seed produced is likely to reach beyond 400 feet (*2*).

Seedling development.—Although germination was affected little by type of seedbed under a controlled greenhouse environment (*11*), type of seedbed had an important influence in the forest. Germination of larch was 2 times as good on a burned seedbed and 3.2 times as good on a mineral soil compared to duff (*14*). In other studies only 4 percent germinated on duff, 13 percent on mineral soil, and 20 percent on ashes (*20*, *22*). It was estimated that 26 sound larch seed are needed to produce one seedling on mineral seedbeds compared to 191 on the forest floor (*32*).

Germination of larch seed probably begins when soil temperatures reach 60° F. and proceeds rapidly at 70° to 80°. Larch associates responded similarly in these temperature ranges (*19*). On cutover slopes at 4,000 feet elevation in northwestern Montana, germination starts about May 1 on south and west aspects and a week later on north aspects. In northern Idaho germination began April 28 in the open and May 20 in full shade, and was essentially complete by June 5 and July 15, respectively (*14*). Germination may start a week to a month later at higher elevations and on shaded north slopes. Stratification or exposure over winter greatly increases the amount of germination.

Losses of seedlings vary according to soil surface and amount of sunlight. Only 15 percent of the larch seedlings in the Western Larch—Douglas-Fir Type of northwestern Montana survived, compared to 54 percent in the Western White Pine Type. The survival of larch seedlings in the Western Larch—Douglas-Fir Type is 5 to 6 times higher on north aspects than on west and south aspects. Generally, larch survival is poor on dry southwest exposures (*18*). On these slopes Douglas-fir becomes established as the dominant species.

Soil fungi cause most early seedling losses. On river flats and benches in the western white pine type first-year seedling losses to fungi are greater on a duff seedbed than on a mineral seedbed in full sunlight and partial shade. However, in the shade, mortality is higher on mineral soil than in duff (*13*).

Insolation usually ranks as the second major cause of death as the growing season advances. Duff again is the least desirable seedbed. Lethal temperatures occur earlier and for many more days on duff during the growing season. In full sun on slight north slopes duff temperatures reached 120° F. on 76 days and 135° on 43 days. On mineral soil 120° occurred for only 8 days, and 135° was not recorded (*13*). On south and west slopes surface temperatures at times exceed 150° on mineral soil in mid-summer. Few seedlings survive on these slopes under full sunlight on either mineral soil or duff.

Later in the growing season after stems harden, losses are generally due to drought, and are greatest in full shade. In shade, root penetration averaged only 1 inch for larch and 2½ inches for Douglas-fir. But in full sun and partial shade, roots of both larch and Douglas-fir frequently penetrate below soil layers that have depleted moisture (*13*).

Larch seedling losses from all seedbeds on cutover areas in northern Idaho were 46 percent the first year and 67 percent for 6 years (*14*).

At the end of the first year larch seedlings are about 2 inches tall. While fully shaded seedlings are small with very short roots, seedlings grown in the sun or in partial shade may have roots as long as 9 inches. Top growth of partially shaded seedlings is usually faster than seedlings grown in full sunlight; but after the first few years seedlings grow best in full sunlight.

With favorable conditions western larch grows rapidly, beginning the second year, and may be 4 feet tall in 4 years. Only lodgepole pine can match juvenile height growth of larch where both are growing on the same site. Early height growth of Douglas-fir is about one-half and Engelmann spruce about one-fourth the growth of larch (*16*).

Needle and shoot growth starts in April or May and is practically complete by July (*4*). Single needles on new seedlings persist for one or more years. Single needles on new shoots, however, are usually deciduous, as are the needle clusters of 14 to 30 needles each on older shoots.

Vegetative reproduction.—Larch does not reproduce by sprouts and techniques for rooting cuttings have not been reported. A few successful grafts have been made by the Intermountain Forest Experiment Station.

Sapling Stage to Maturity

Growth and yield.—Larch is a long-lived tree

and may attain large sizes. Many trees in the Seeley Lake grove in Montana are more than 700 years old; the largest tree measured 88 inches d.b.h. One windthrown monarch was 915 years old (*17*), and a tree found on the Kootenai National Forest in northwestern Montana measured 91 inches d.b.h. In a 380-year-old stand, the tallest trees were 175 feet and 55 inches d.b.h. (*18*).

Height growth of larch is rapid and diameter growth is moderate until the trees are 75 to 100 years old. On the same site only lodgepole pine equals larch in height growth during early years, but eventually larch outstrips the pine. Larch may be 19 feet tall in 15 years (*6*); annual height growth may average 1.5 feet between ages 14 and 20 (*4*). Average heights of larch at different ages are as follows (*18*):

Age (years)	*Height (feet)*
10	12
30	33
50	50
70	65
90	77
120	90

Diameters may reach 16 inches at 80 years under favorable conditions, but radial growth usually declines thereafter. Frequently 250-year-old stands average only 16 to 24 inches in diameter (*36*) and 400-year-old stands, 30 inches (*18*).

Usually radial growth begins in April at low altitudes, but is delayed a month or more at high altitudes and on cool sites. In 1942 growth began April 19 at an elevation of 3,238 feet in Idaho; but it did not begin until May at 4,822 feet. Growth at low levels was substantially better than at higher levels and growth culminated about mid-July at both elevations. Radial shrinkage occurred during the dry period in late summer, but after fall rains original dimensions were regained and surpassed (*9*).

F–350566

Old growth larch stand in Montana.

The growth potential of western larch, by age classes, for three different site index conditions is given in table 1.

TABLE 1.—*Average diameter, total height and volume per acre for stands of western larch by age and by site index class*

Site index	Age	Diameter breast high	Total height	Volume	
	Years	*Ft.*	*Ft.*	*Cu. ft.*	*Bd. ft.*
55 (medium)	80	10.8	79	16.22	66
	100	12.8	91	26.24	117
	120	14.8	101	38.72	189
75 (good)	80	13.8	103	34.52	162
	100	16.5	118	55.58	288
	120	19.0	130	78.34	434
95 (very good)	80	16.7	135	64.76	342
	100	20.0	152	100.32	566
	120	23.3	167	154.13	911

The expected yield of larch stands is high. A volume of 60,000 board feet per acre for a 380-year-old stand has been reported (*18*). However, many stands contain volumes of 20,000 board feet and less. Estimated yields for fully stocked stands in the larch—Douglas-fir type are given in table 2.

TABLE 2.—*Estimated average yield of fully stocked larch stands in the larch-Douglas-fir type for trees 13.0 inches d.b.h. and larger* (*5*)

Site class	Average height dominant and codominant age—100	Volume per acre at—		
		100 years	140 years	200 years
	Ft.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
I	121	43,500	69,800	94,600
II	107	25,400	51,200	74,500
III	94	11,200	29,100	51,600
IV	80	4,000	10,200	23,100
V	66	300	2,000	6,000

Reaction to competition.—Larch is intolerant through its entire life except in the early seedling stage when partial shade is tolerated (*1*, *14*). It

is more intolerant than its associates. Larch will lose dominance to the more tolerant species if overtopped (*14*). Harvest cuttings favor establishment of larch, but fast-growing advance growth of other species may prevent the establishment of new reproduction in the dominant stand (*27*).

Trees more than 200 years old respond to release. Individual trees make the greatest response when cutting is heavy, but the degree of response is correlated directly with vigor (*29*). Larch responds better than Douglas-fir in fair- and good-vigor classes, but Douglas-fir usually exceeds larch in actual growth. In a tree vigor classification system, larch in the best-vigor group grows nearly one and one-half times as much volume as the average of all trees (*28*).

Competition is not restricted to trees of similar size in larch stands but may include a tolerant understory. Diameter growth of residual larch on a seed-tree cutting increased 67 percent over prelogging growth. All understory trees were cut and growth increased an additional 36 percent. Growth of Douglas-fir accelerated 42 percent after cutting but did not make an additional response after the understory was removed (*33*).

Trees 50 years old responded to release by producing sprouts on the bole. The occurrence and degree of sprouting are correlated directly with amount of release. Sprouts developed on the pruned sections of 54 percent of larch crop trees released by heavy thinning, but only 24 percent sprouted with medium thinning. Branches tended to develop in the upper half of pruned sections of the former group and in the upper quarter of the latter.

Principal enemies.—Mature larch is more fire resistant than any of its associates. The 3- to 6-inch thick basal bark is good fire protection (*6*, *36*). However, sapling- and pole-sized trees are easily killed by fire.

Larch has excellent anchorage from a deep, wide-spreading root system; consequently, it is moderately resistant to windthrow.

Dwarfmistletoe (*Arceuthobium campylopodum* forma *laricis*) is a serious disease of larch. It may infect trees from 3 to 7 years of age, continuing throughout the life of the tree. Mistletoe enters shoots 4 years old or younger (*38*). Reduction in diameter and height growth occurs regardless of age, stocking, or growth potential of the soil (*26*). A tree with several brooms in a full healthy crown will have a growth rate similar to that of an uninfected tree with a crown of similar size to the healthy portion of the infected tree (*26*). Slight infections may reduce growth to three-fourths of average, and severe infections may reduce growth to one-half of normal in young trees (*12*). Infected trees 144 years old averaged 63 feet in height and 11.5 inches d.b.h., while uninfected trees averaged 115 feet in height and 19.5 inches d.b.h. Besides reducing growth, mistletoe kills outright, causes spiketops, creates entrances for insects and fungi, causes burls and brashness, and reduces vitality of seed (*38*).

As the brooms enlarge on the host tree they take up more effective crown space and contribute little or no food production to the tree. Finally, the broom grows to the point where its weight breaks the branch. Epicormic branches frequently occur when self-pruning occurs but they do not attain the size of the original limbs and the tree is not able to regain its former growth potential (*26*).

Larch is infected by three other important diseases: the brown trunk rot caused by the quinine fungus, *Fomes officinalis*; red ring rot caused by *Fomes pini;* and needlecast caused by *Hypodermella laricis.* Many other diseases of lesser importance have been reported on larch (*35*).

Industrial fumes do not seriously affect the foliage of western larch because of its deciduous needles. However, young larch foliage is very sensitive to noxious fumes but becomes less susceptible to damage as the season progresses (*23*).

The larch casebearer (*Coleophora laricella*) is currently the most serious pest of western larch. It was first reported attacking in 1957 (*7*). Heavy damage is sporadically caused by the larch sawfly (*Pristiphora erichsonii*) and the larch budmoth (*Zeiraphera griseana*). The two-lined larch sawfly (*Anoplonyx occidens*), the western larch sawfly (*Anoplonyx laricivorus*), and a looper (*Semiothisa sexmaculata*) occasionally cause damage. Other insects of lesser importance are the bark beetle (*Dendroctonus pseudotsugae*), the spruce budworm (*Choristoneura fumiferana*), and the false hemlock loper (*Nepytia canosaria*). The sawtooth pine engraver (*Ips integer*) usually attacks dying and felled trees. Other minor pests cause infrequent damage.

SPECIAL FEATURES

Galactan, a water-soluble gum distinguishes western larch wood from other softwoods (*15*). This gum is concentrated in the lower part of the tree.

As in European larch, the oleoresin of western larch can be used to produce "Venice" turpentine and related products. The western larch product has the consistency of honey, is light amber in color, and has a slightly bitter taste but an agreeable odor. It contains 16 percent volatile pinene and limonene (*24*).

RACES AND HYBRIDS

Races and hybrids of western larch are not known.

Revised from "Silvics of Western Larch," by Kenneth N. Boe, U.S. Forest Serv. Intermountain Forest and Range Expt. Sta. Misc. Pub. 16, 17 pp. 1958.

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